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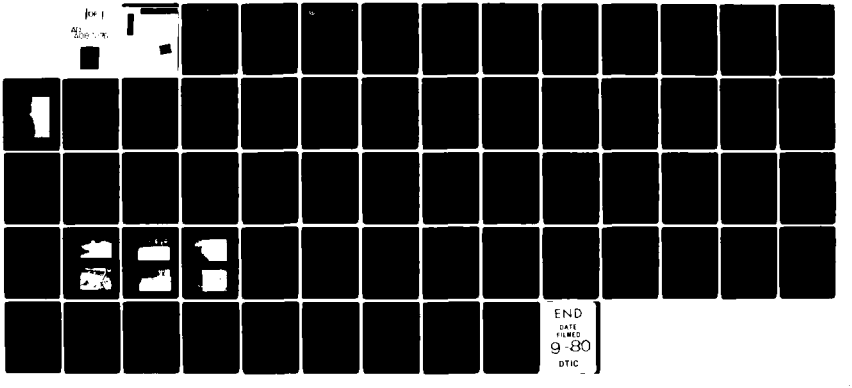

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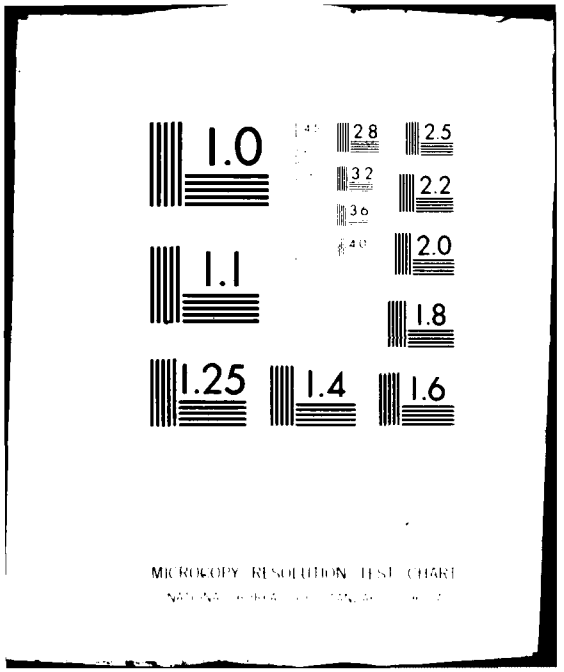
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LEVEL II

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NJ00042
2. GOVT ACCESSION NO.: AD-A087276
3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): ~~Phase I Inspection Report~~ National Dam Safety Program. Indian Mills Dam, ~~Burlington County~~ (NJ00042) ~~New Jersey~~ Atlantic Coast Basin, Muskingum Brook, Burlington County, New Jersey, Phase 1 Inspection Report.
5. TYPE OF REPORT & PERIOD COVERED: FINAL rept.
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7. AUTHOR(s): ~~Rudolph Wrubel, PE~~
8. CONTRACT OR GRANT NUMBER(s): DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Louis Berger & Associates, 100 Halstead St., East Orange, NJ 07019 (12 63)
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: NJ Department of Environmental Protection, Division of Water Resources, P.O. Box CN029, Trenton, NJ 08625 (11)
12. REPORT DATE: Feb~~ruary~~ 1980
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18. SUPPLEMENTARY NOTES: Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Indian Mills Dam, NJ
Spillways
Structural analysis
National Dam Safety Program
Embankments
Slopes

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

LEVEL II

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

23 JUN 1980

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Indian Mills Dam in Burlington County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Indian Mills Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of these inspections, is judged to be in an UNSAFE, non-emergency condition. The dam's stability is considered questionable by the personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. Also, the spillway is considered inadequate because a flow equivalent to 18 percent of the 100 Year Design Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions as a minimum are recommended.

a. Within thirty days from the date of approval of this report, the following remedial measures should be initiated:

(1) The spillway structure should be replaced at the outlet sluices and a substantial part of the embankment in that area should be rebuilt. Geotechnical investigations should be performed at selected points to analyze the properties of the materials in the embankment and to derive piezometer readings in the embankment and foundation material.

(2) The remainder of the adjacent embankment slopes should be regraded, aligned, and compacted to stable design slopes and be protected by riprap or its equivalent upstream and by an effective vegetative cover downstream. The large trees growing on the downstream face should be removed.

NAPEN-N
Honorable Brendan T. Byrne

b. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should by promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

c. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Forsythe of the Sixth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

INDIAN MILLS DAM (NJ00042)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 21 November and 27 December 1979 by Louis Berger and Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Subsequent inspection of Indian Mills Dam on 6 February 1980 by Corps and State personnel revealed the dam to be in an UNSAFE, non-emergency condition. This condition, erosion, including a series of large gullies on the upstream and downstream sides of the dam crest in the vicinity of the outlet sluices, if left uncorrected, could have resulted in failure of the dam with subsequent possible loss of life and property damage. Until further study could determine the full extent of the problem and possible permanent remedial actions, temporary measures were recommended to preclude serious property damage and possible loss of life. The District Engineer notified the Governor's representative by telegram of the UNSAFE condition on 7 February 1980. (Copy attached to this assessment) (Also, an "UNSAFE DAM" data sheet was submitted to the U.S. Army Engineer Division, North Atlantic on 7 February 1980. A copy of this sheet is attached). Meanwhile, the State notified the owner by letter of the recommendations. The owner has lowered the level of the lake as recommended.

Indian Mills Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of these inspections, is judged to be in an UNSAFE, non-emergency condition. The dam's stability is considered questionable by the personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. Also, the spillway is considered inadequate because a flow equivalent to 18 percent of the 100 Year Design Flood would cause the dam to be overtopped. To ensure adequacy of the structure, the following actions as a minimum are recommended.

a. Within thirty days from the date of approval of this report, the following remedial measures should be initiated:

(1) The spillway structure should be replaced at the outlet sluices and a substantial part of the embankment in that area should be rebuilt. Geotechnical investigations should be performed at selected points to analyze the properties of the materials in the embankment and to derive piezometer readings in the embankment and foundation material.

(2) The remainder of the adjacent embankment slopes should be regraded, aligned, and compacted to stable design slopes and be protected by riprap or its equivalent upstream and by an effective vegetative cover downstream. The large trees growing on the downstream face should be removed.

b. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should by promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

c. Within one year from the date of approval of this report, the owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 19 JUN 1980

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

25 FEB 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Joint Inspection of Indian Mills Dam (NJ 00042), located in Shamong Township, Burlington County, New Jersey, by representatives of this office and the New Jersey Department of Environmental Protection on 6 February 1980, revealed the dam to be in an UNSAFE, non-emergency condition. This condition, erosion, including a series of large gullies on both sides of the dam crest in the vicinity of the outlet sluices, if left uncorrected, could result in failure of the dam with subsequent possible loss of life and property damage.

Until further study can determine the full extent of the problem and possible permanent remedial actions, the following temporary measures, as a minimum, are recommended to preclude serious property damage and possible loss of life:

a. Reconstruct the dam section at the outlet sluices to a section comparable to that to the left and right sides of the eroded section within 30 days.

b. Local authorities should immediately prepare an emergency warning and evacuation plan including a surveillance program for use during periods of heavy rainfall.

Mr. John O'Dowd P.E., Chief, Bureau of Flood Plain Management, New Jersey Department of Environmental Protection was notified of the condition by telephone and telegram on 7 February 1980.

NAREN-N
Honorable Brendan T. Byrne

Your cooperation in implementing these measures will be appreciated.

Sincerely,

JAMES G. TOM
Colonel, Corps of Engineers
District Engineer

Copy Furnished:
Mr. John O'Dowd P.E.
Chief Bureau of Flood Plain Management
Department of Environmental Protection
1474 Prospect Street
Trenton, New Jersey 08625

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PMS MR. JOHN O'DOWD, P.E., CHIEF BUR. FLOOD PLAIN MGT

N.J. DEPT OF ENVIRON. PROT.

1474 PROSPECT ST TRENTON, NJ 08625

INSPECTIONO OF INDIAN MILLS DAM (FED. ID. NJ00042), LOCATED IN SHAMONG TOWNSHIP, BURLINGTON COUNTY, NEW JERSEY, REVEALED THE DAM TO BE IN AN UNSAFE, NON-EMERGENCY CONDITION. THIS CONDITION, EROSION INCLUDING A SERIES OF LARGE GULLIES ON THE UPSTREAM AND DOWNSTREAM SIDES OF THE DAM CREST IN THE VICINITY OF THE OUTLET SLUICES, IF LEFT UNCORRECTED, COULD RESULT IN FAILURE OF THE DAM WITH SUBSEQUENT POSSIBLE LOSS OF LIFE AND PROPERTY DAMAGE.

UNTIL FURTHER STUDY CAN DETERMINE THE FULL EXTENT OF THE PROBLEM AND POSSIBLE PERMANENT REMEDIAL ACTIONS, THE FOLLOWING TEMPORARY MEASURES, AS A MININUM, ARE RECOMMENDED TO PRECLUDE SERIOUS PROPERTY DAMAGE AND POSSIBLE LOSS OF LIFE.

A. RECONSTRUCT THE DAM SECTION AT THE OUTLET SLUICES TO A SECTION COMPARABLE TO THAT TO THE LEFT AND RIGHT SIDES OF THE ERODED SECTION. MATERIALS USED ON THE UPSTREAM SIDE SHOULD BE CAPABLE OF RESISTING WAVE EROSION. THIS SHOULD BE COMPLETED WITHIN 30 DAYS.

B. LOCAL AUTHORITIES SHOULD PREPARE AN EMERGENCY WARNING AND EVACUATION PLAN, IMMEDIATELY, INCLUDING A SURVEILLANCE PROGRAM FOR USE DURING PERIODS OF HEAVY RAINFALL. A LETTER WILL BE SENT TO GOVERNOR BYRNE FULLY EXPLAINING THE SITUATION. THIS TELEGRAM IS SENT SO YOU MAY EXPEDITE ACTION.

JAMES G. TON, COL, CORPS OF ENGINEERS, CUSTOM HOUSE 2ND & CHESTNUT STS., PHILA., PA 19106

UNSAFE DAM REPORT
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Indian Mills Dam

b. ID NO.: NJ00042

c. LOCATION State: NJ County: Burlington
River or Stream: Muskingum Brook
Nearest D/D City or Town: Indian Mills

d. HEIGHT: 11 feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 483 ac-ft

f. TYPE: Earth Embankment

g. OWNER: Shamong Township

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 7 Feb 80

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT: Erosion, including a series of large gullies on both sides of the dam crest in the vicinity of the outlet sluices.

1. URGENCY CATEGORY: Non-Emergency

j. DESCRIPTION OF DANGER INVOLVED: Overtopping and failure could result in loss of life and property damages to residences downstream of dam.

m. EMERGENCY ACTIONS TAKEN: Governor's Representative notified by telephone and telegram to tell the owner to reconstruct the dam section at the outlet sluices to a section comparable to that to the left and right sides of the eroded section within 30 days.

k. RECOMMENDATIONS GIVEN TO GOVERNOR: Letter being prepared to Governor stating full problem with temporary remedial action required. Governor's Representative informed of situation by telephone and telegram on 7 Feb 80.

n. REMEDIAL ACTIONS TAKEN: Governor's Representative will notify owner to complete the above in 30 days.

o. REMARKS: As additional actions and information becomes available, this report will be updated.

T. B. Heverin
Coordinator, Dam Inspection Program
U.S.A.E.D., Philadelphia
7 February 1980

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Indian Mills Dam, Fed ID# NJ00042
NJ ID# 32-2

State Located New Jersey
County Located Burlington
Coordinates Lat. 3950.7 - Long. 7445.1
Stream Muskingum Brook
Dates of Inspections 11/21/79, 12/27/79

ASSESSMENT OF GENERAL CONDITIONS

Indian Mills Dam is assessed to be in a poor overall condition and the embankment in the vicinity of the box inlet spillway is in imminent danger of breaching. The dam is considered to be in an unsafe,non-emergency condition and is recommended to be placed in a significant hazard category.

Remedial actions to be undertaken immediately are 1) regrade the upstream face and place riprap protection in selected areas where wave action has scoured out the slope, 2) regrade and stabilize the downstream slopes, 3) remove dead root systems and trees from the embankment.

Additonal design studies should be undertaken regarding the advisibility of rebuilding the spillway and the possible construction of an auxiliary overflow spillway.

The present spillway will accommodate only 17% of the 100 year design flood and is therefore inadequate.

R. Wrubel
Vice President
Louis Berger & Associates, Inc.

OVERVIEW OF INDIAN MILLS DAM

December, 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: INDIAN MILLS DAM FED ID# NJ 00042
NJ ID# 32-2

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of Indian Mills Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Indian Mills Dam is a moderately old earth embankment approximately 600 feet long, with a timber box spillway located about 200 feet from the right, or west, abutment. The rectangular box measures approximately 14 feet by 3 feet and is divided into four spillway compartments, each inlet being about 3.5 feet wide. Vertical alignment is fair along the footpath of the crest but horizontal is poor from severe erosion on both upstream and downstream slopes. The only other outlet below crest elevation is a naturally formed emergency spillway along a slightly depressed old roadway at the right end of the dam.

b. Location

The dam is built across Muskingum Brook just west of Route 206, and north of the connecting Willow

Grove Road into the village of Indian Mills in Burlington County, New Jersey. Drainage proceeds southwest from this point through Wharton State Forest and ultimately via the Mullica River to the Atlantic Ocean. About one half mile below the dam, Muskingum Brook merges with Indian Mills Brook and becomes Springers Brook.

c. Size Classification

The maximum height of the dam is eleven feet and the maximum storage is estimated to be 483 acre-feet. Therefore, the dam is placed in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

Based on the Corps of Engineers criteria and the fact that in the event of a failure the only apparent damage that might be inflicted downstream is to two small culverts and Willow Grove Road which is just below the embankment, the classification is recommended to be downgraded to a significant hazard. There is only one residence that might be adversely affected should the dam collapse and thus, only a few lives might be endangered.

e. Ownership

The dam is reputedly owned by Shamong Township, Stokes Road R.D., Vincentown, New Jersey 08088 although it apparently had a private owner within recent times. Mr. C. Kenneth Anderson is the Township Engineer and can be contacted at 609-267-1210.

f. Purpose of Dam

The dam impounds a recreation lake with residential development along a portion of the western shore.

g. Design and Construction History

According to records of the New Jersey State Water Policy Commission, the dam dates back to at least 1923 when it was used for seasonal flooding of cranberry bogs. It was inspected in 1953, reportedly years after a failure which left a 50

foot gap, with a view to reconstruction to form a lake for recreation or real estate development. Apparently an old mill existed in the vicinity of the present spillway. Although specific information is lacking, it is assumed that the present dam may have originated at or about that time. Mention of remains of an earlier millrace may have been based on traces of the old spillway. Correspondence in 1968 refers to dewatering for necessary repairs. The dam apparently was breached again around 1974, rebuilt, and inspected by the State which resulted in recommendations that both faces be modified to 2H:1V or flatter, the entire upstream slope protected by riprap and the crest raised two feet. The spillway was called grossly inadequate. These recommendations were never followed. Again in 1978 a series of letters recommended slope improvement and protection, repair of the spillway, and removal of trees from the embankment. No details were available regarding actual design or construction. It was noted that the home just below the right abutment is the historic "Thompson" house and was built in 1807 and was the site of an earlier Indian gristmill which was burned in 1762.

h. Normal Operating Procedures

Particular operating and maintenance procedures are not known, but observation of the general installation makes it apparent that they are quite limited (see Section 4).

1.3 PERTINENT DATA

a. Drainage Area

The area is 5.85 square miles of relatively level rolling countryside of rural development, second-growth woodlands and cranberry bogs.

b. Discharge of Damsite

Spillway capacity at maximum pool (top of dam) is 487 cfs.

c. Elevations (Ft. above MSL)

Top of dam (maximum pool) - 78.0
Recreation pool (spillway crest) - 74.0
Streambed - 67±

d. Reservoir

Length of maximum pool - 8000 feet
Length of recreation pool - 3400 feet

e. Storage (acre-feet)

Maximum pool - 483 (Top of dam)
Recreation pool - 160

f. Reservoir Surface (Acres)

Maximum pool - 247
Recreation pool - 40

g. Dam

Type - Earth embankment with timber drop inlet spillway
Length - 600 feet
Height - 11 feet
Top width - varies (12-15 feet; 1 foot in vicinity of spillway)
Side slopes varies (vert. to 1:1)
Zoning and core - unknown

h. Diversion and Regulating Tunnel - None

i. Spillway

Type - Timber multi-cell box drop inlet
Overall length - 12 feet (effective)
Crest elevation - 74.0 MSL
U/S Channel - main reservoir
D/S Channel - natural streambed

j. Regulating Outlets

Type - removable timber flashboards in spillway.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No plans or computations were available.

2.2 CONSTRUCTION

No information was available.

2.3 OPERATION

As indicated in paragraph 1.2 g., the dam has operated essentially in its present form since about 1953. It has suffered a number of breaches since that time, mainly in the spillway vicinity.

2.4 EVALUATION

In view of the size and hazard classification, it is felt that direct examination can successfully compensate for a lack of data for the purposes of assessment of this dam included in this report. Any refinement of the recommendations that are made would require further study. Although no data was acquired upon which to base a cogent assessment of the earthwork embankment, erosion in the area of the spillway exposed the following soils profile:

0'-1' Greyish brown fine sand, little to some clayey silt.

1'-7' Orange coarse to fine sand, little to some plastic fines, very moist in some sections.

The dam is located in the west central part of the Burlington County and is within the outer zone of the Coastal Plain physiographic province. It is situated in a narrow strip of land where the surficial soils are comprised of recent alluvium that is mixed with and overlies swampy soils. The alluvium is mainly silt and sand with some clay.

Beyond the band of alluvium that is adjacent to the stream course the surficial soils are comprised of marine stratified deposits, primarily of the Cohansey formation. These soils underlie the recent alluvium layers and lenses of clay, clayey sand and sand. In general, the clayey soils occur at depths greater than ten feet below the top of the formation.

SECTION 3 - VISUAL INSPECTION

3.1 a. General

Visual inspections were conducted on 21 November and 26 December 1979. The reservoir appeared to be at a relatively stable level judging by the growth of grasses along the water edge, but was at a stage slightly below what might be more desirable relative to the lake front properties. Water was flowing through three of the separate compartments of the spillway but the fourth cell is completely blocked.

b. Dam

Embankment slopes are oversteepened and irregular throughout, both up and downstream. Their angle is characteristically sharper than 1H:1V, and they are also marked by severe gullying from the crest. Effects are especially bad at the spillway where a series of large gullies on opposite faces are on the verge of joining at the dam crest. The material composing the embankment as exposed by the erosion are about one foot of silty fine sand at the surface overlying six feet of coarser sand with less binder. Four large trees, up to 36 inches in diameter, are growing on the downstream slope about 30 feet east of the spillway. One 20 inch tree has been cut down but its roots remain in place. Slopes otherwise are covered with weeds, brush, and smaller trees except in those areas undergoing active erosion. Possible seepage is hard to define since much of the immediate downstream land is marshy. No slope protection measures are evident anywhere as are no visible effects of any recent maintenance of the embankment slopes or crest.

c. Appurtenant Structures

The timber box spillway appears to be in fair condition despite its light construction relative to its size. It has apparently been repaired occasionally. The outlet may have a comparable configuration to the four compartments of the intake, one of which was plugged up, and is normally submerged. Nothing is known of any foundation treatment, or of the actual conditon of the greater part of the spillway structure. The

four intake gates have removable boards which show little sign of recent use, and the back of the structure simply has four corresponding openings that are fixed and useful only for higher flows. Short sections of wooden cutoff walls, driven to an unknown depth, extend laterally from the ends of the intake box. The volume of flow at the time of inspection (several inches over the flashboard crest) is choking the drop inlets by forming a vortex in the vertical shaft and this may have been caused by the blockage in one of the four chambers.

An old roadway near the right abutment additionally serves as an irregular emergency spillway as its crest is a foot below the dam crest. This overflow discharges between the garage and the historically-cited Thompson House. A considerable seepage area was observed in this vicinity.

d. Reservoir

Indian Mills Lake appears to be a fairly stable, shallow pool that was clear of debris at the time of inspection. The surrounding land is relatively flat and there are no notable slopes. Residential development is sparse with the only concentration occurring along the lower right shoreline. Much of the remaining border is marshy for broad areas before reaching fields or woodland. Siltation does not seem to be a problem but weed growth is probably active.

e. Downstream Channel

The outlet of the dam discharges into a broad, shallow ill-defined channel that merges with adjoining marshland. Flow did not appear to be active enough to cause any appreciable scour. The difference between head and tailwater levels when inspected was 4.5 feet. County Road #532 and a small (3x16) timber bridge are about 150 feet downstream, after which the stream follows a well established natural channel within a wide flood plain which is completely undeveloped. The brook merges with Indian Mills Brook about 0.5 mile further downstream.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not physically observed by the inspection team. There appears to be no formally established schedules for inspection or maintenance.

4.2 MAINTENANCE OF DAM

The timber box inlet is maintained by township forces in a workmanlike fashion as part of their continual program. There has apparently been little maintenance of the embankment in recent times.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only operable facilities are the removable flashboards on the box inlet. These apparently have not been adjusted in recent times.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

None exists except for monitoring by local residents and township personnel during periods of heavy storms.

4.5 EVALUATION

In view of the height of dam and the somewhat inaccessible position of the drop inlet, operational procedures are deemed to be less than completely adequate to prevent overtopping and breaching of the embankment in the vicinity of the spillway. The capacity of the outlet is presently severely restricted although flood conditions are alleviated by the natural overflow depression that exists near the right abutment. It is doubtful however that improvement of operating procedures can circumvent any serious overtopping floods and lessen the breaching potential that presently exists. Close monitoring could establish the closing of Route 534 to traffic during flooding. This roadway is several feet below dam crest.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Based on the criteria in the Recommended Guidelines for Safety Inspection of Dams, Indian Mills Dam is small in size and is placed in the significant hazard category. Accordingly, a 100-year frequency event was selected as the design storm and a inflow hydrograph was calculated using precipitation data from Technical Paper 40 and NOAA Technical Memorandum NWS Hydro-35. Inflow to the reservoir was calculated utilizing the HEC-1 computer program, discharging a peak into the reservor of 4447 cfs. Routing this through the reservoir reduced the peak to 2946 cfs. The spillway capacity before overtopping of the dam occurs is approximately 487 cfs and can therefore can accommodate only 17% of the design flood.

b. Experience Data

Records reveal that the dam was washed out for many years prior to 1953 but except for minor repairs to the drop inlet, has withstood repeated flooding since that time. Official inspections in 1974 and 1978 revealed that the spillway and embankment slopes should be rebuilt and the spillway capacity enlarged, based on a mean of the north and central New Jersey curves (which yielded a discharge of 950 cfs).

c. Visual Observations

Because the outlet sluices are completely buried and/or submerged, their capacity and condition could not be evaluated. It was noted that their outlets appear to be normally submerged except during dry periods. Further, as stated before, one of the cells is blocked and further restricts the discharge capacity. It was also observed that the thickness of timber employed in parts of the inlet are extremely thin and were probably installed as temporary replacements for broken pieces.

d. Overtopping Potential

The hydraulic analysis indicates a considerable potential for overtopping and especially breaching

in the vicinity of the spillway. The design flood theoretically overtops the dam by approximately 3 feet but it was noted that the surrounding terrain is extremely flat and attaining this flood height is highly unlikely. It was noted that at the 80 MSL contour (2 feet above dam crest) storage area increases to 350 acres, a 875% increases over the normal reservoir area.

e. Drawdown

Dewatering could be accomplished by removing one or more of the timber flashboards. Assuming 1) tailwater remains constant, 2) an inflow of 1 cfs per square mile of drainage area and 3) an operatable depth of 5 feet, the reservoir could be drawndown in approximately 1 day using all four of the gates.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Based on the visual inspection Indian Mills Dam is evaluated as being in poor structural condition and is in imminent danger of being breached at the spillway. The dam has apparently failed on a number of previous occasions, usually in the same general area of the stream channel and spillway. Erosion of the same area is now sufficiently advanced in the erodible and completely unprotected embankment material that another breach is possibly close at hand. No more than a one foot equivalent thickness remains at some points along the crest of the embankment. The remainder of the embankment is considered relatively stable although also subject to persistent erosion, possible seepage, and piping around tree roots. Not enough is known of the spillway structure, but its structure seems questionable and its function is presently deficient.

b. Design and Construction Data

None is available. The field review reveals that the spillway is of questionable long-term strength.

c. Operating Records

No records exist.

d. Post Construction Changes

It is believed that no significant changes have been made since construction of the spillway in 1953. In 1978, the N.J. Bureau of Flood Plain Management directed the owners to undertake repairs but this directive has apparently not been addressed.

e. Seismic Stability

Indian Mills Dam is located in Zone 1 and is statically stable. Experience indicates that dams in this seismic zone will have adequate stability under dynamic loading conditions if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, Indian Mills is classified as being in poor overall condition. Furthermore, the spillway is incapable of passing the spillway design flood. Most of the embankment is built of unknown composition, but where it has been exposed by advanced erosion it appears to be largely granular and not highly impermeable. The present spillway does not meet the requirements of the Recommended Guidelines for Safety Inspection of Dams, being able to accommodate only 17% of the spillway design flood as calculated by the Corps of Engineers criteria. Overtopping of the dam in its present condition could be expected to breach the crest in the area of the spillway and cause considerable damage; hence its condition is adjudged to be unsafe, nonemergency.

b. Adequacy of Information

The information obtained is limited, but it is deemed adequate for the Phase I inspection. It is believed that little else is available. Performance data is also believed to be non-existent. However, in view of the hazard classification, the available information is considered satisfactory for the assessment contained herein.

c. Urgency

Although the urgency for further action is mitigated by the very low density of downstream development, the condition of the dam is such that a start on correcting some of the most basic problems should be made without delay.

d. Necessity for Further Study

Because the structural stability of major parts of the dam cannot be ascertained with certainty, apart from the section that is clearly unstable, the obtaining of additional information is

recommended. Geotechnical investigations should be performed at selected points to analyze properties of the materials of the embankment and to derive piezometer readings in the embankment and foundation material. Also, the hydraulics should be further reviewed to study the feasibility of constructing a new spillway.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

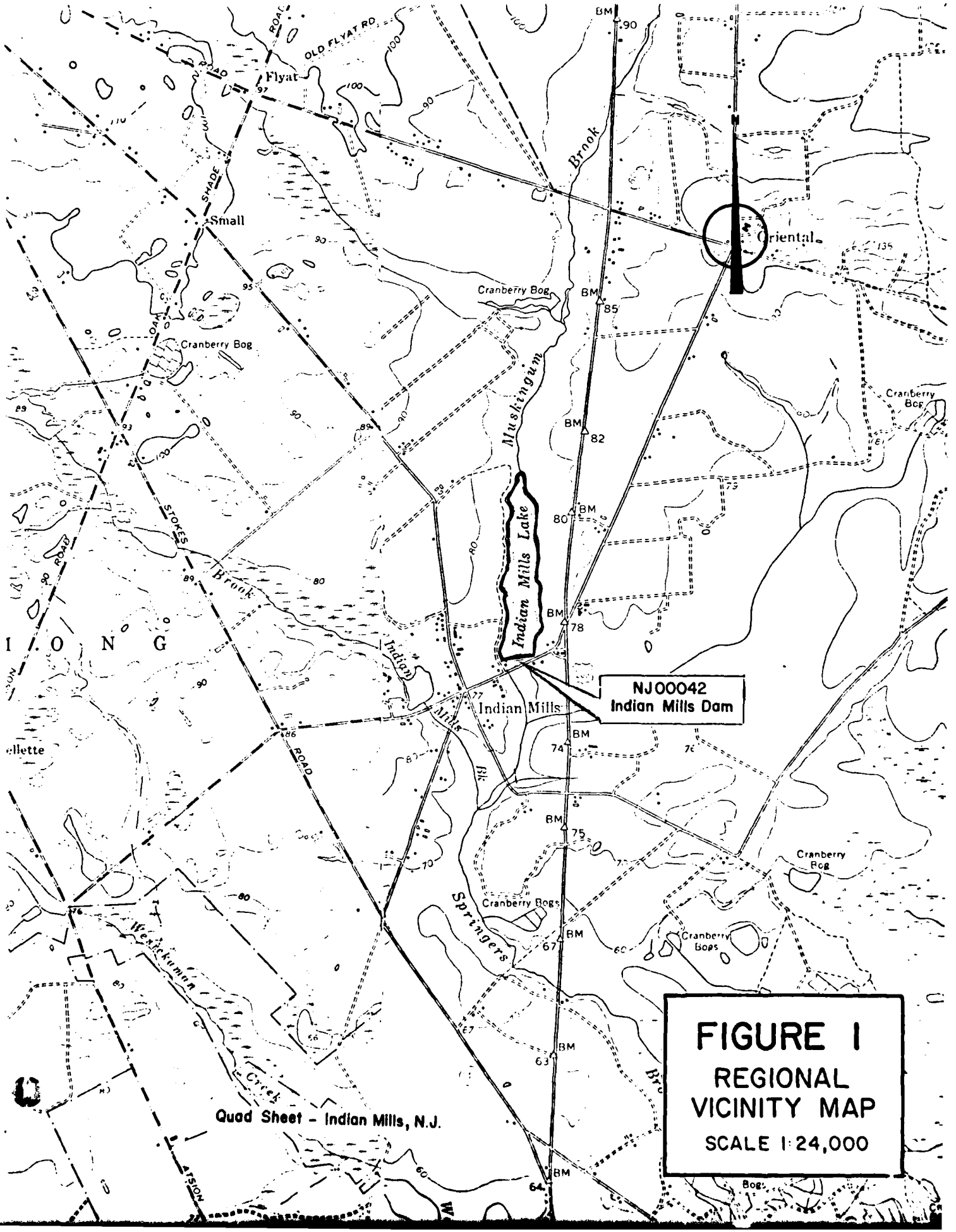
a. Recommendations

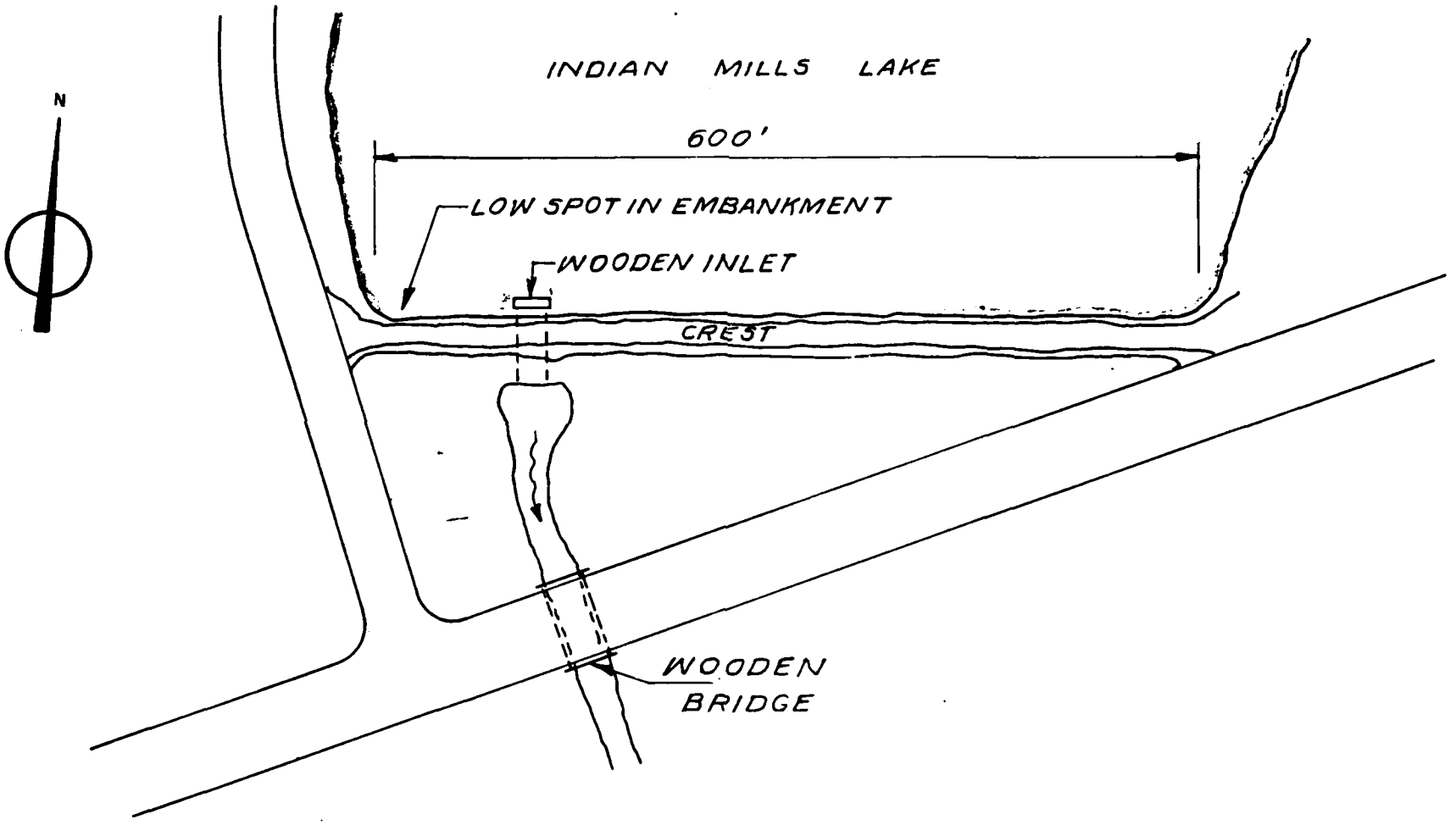
1. By far the best resolution of the problems of this dam would start with complete replacement of the spillway structure, and rebuilding of a substantial part of the embankment in that area.

2. The remainder of the adjacent embankment slopes should be regraded, aligned, and compacted to stable design slopes and be protected by riprap or its equivalent upstream and by an effective vegetative cover downstream. The large trees growing on the downstream face shall first be removed along with their root systems.

b. O&M Maintenance and Procedures

It is recommended that regular procedures be developed, and responsibility for them be assigned, including a checklist of periodic maintenance inspections so that records of conditions and repairs can be maintained.


NJ00042
Indian Mills Dam
Indian Mills Lake
Mushingum Brook
Indian Mills
Cranberry Bog
Cranberry Bogs
Springers Brook
Stokes Road
Old Flyat Rd.
Flyat
Small
Oriental
Quad Sheet - Indian Mills, N.J.
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24,000



LOCATION PLAN
NOT TO SCALE

FIGURE 2

Check List
Visual Inspection
Phase 1

Name Dam Indian Mills County Burlington State New Jersey Coordinators NJDEP

Date(s) Inspection 11-21-79 / 12-27-79 Weather Sunny Temperature 70° F

Pool Elevation at Time of Inspection 74± M.S.L. Tailwater at Time of Inspection 70± M.S.L.

Inspection Personnel:

L. Baines J. Voorhees

D. Lang K. Jolls

E. Simone

D. Lang Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Evident on d/s slopes.	Minor.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Severe erosion on both front and back faces of sideslopes especially around spillway. Sloughing along east end in the places of heavy pedestrian traffic.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Vertical alignment is fair, horizontal alignment poor.	
RIPRAP FAILURES	No riprap.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	4 large trees 36" on d/s slope 30' east of spillway.	Low auxiliary spillway zone near right abutment (at farm-house barn).
ANY NOTICEABLE SEEPAGE	Seepage hard to detect since all backslopes are affected by low lying marsh.	Most of d/s toe flooded at time of inspection.
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A	All timber construction.
INTAKE STRUCTURE	All timber construction, fair working shape One box not flowing at all.	Conduit under dam crest appears to be plugged.
OUTLET STRUCTURE	Timber boxes exit into d/s channel.	Boxes appear to be submerged constantly.
OUTLET CHANNEL	Natural stream bed through swampy d/s area.	
EMERGENCY GATE	Low spot on west end old driveway 2-2.5' lower.	Effectively acts as emergency overflow.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Timber overflow box.Wpod in fair condition. 4 inlets 43" wide 33" deep, height unknown.	
APPROACH CHANNEL	Indian Mills Lake main reservoir.	
DISCHARGE CHANNEL	Low lying marshy area, county road and bridge 50 yards d/s.	
BRIDGE AND PIERS	None .	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Flat on all sides, west side has housing, landscaped lawns 2-3' above. East side all low marshy area, marsh weeds etc.	
SEDIMENTATION	Minor	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	County Road #532 and a small (3x16) timber bridge.	
SLOPES	Shallow ill-defined channel.	
APPROXIMATE NO. OF HOMES AND POPULATION	1 home - Historic "Thompson" house. Built in 1807.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Not available.
REGIONAL VICINITY MAP	Available - USGS Quad - Indian Mills, N.J.
CONSTRUCTION HISTORY	Not available.
TYPICAL SECTIONS OF DAM	Not available.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	Not available.
- DETAILS	Not available.
-CONSTRAINTS	Not available.
-DISCHARGE RATINGS	Not available.
RAINFALL/RESERVOIR RECORDS	None available.

ITEM	REMARKS
SPILLWAY PLAN	Not available.
SECTIONS	None available.
DETAILS	None available.
OPERATING EQUIPMENT PLANS & DETAILS	None available.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS	None available.
HYDROLOGY & HYDRAULICS	None available.
DAM STABILITY	Not available.
SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS	None available.
BORING RECORDS	None available.
LABORATORY	None available.
FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM	
DESCRIPTION	None available.
REPORTS	None available.
MAINTENANCE OPERATION RECORDS	None available.

February, 1980

View of Indian Mills Dam

February, 1980

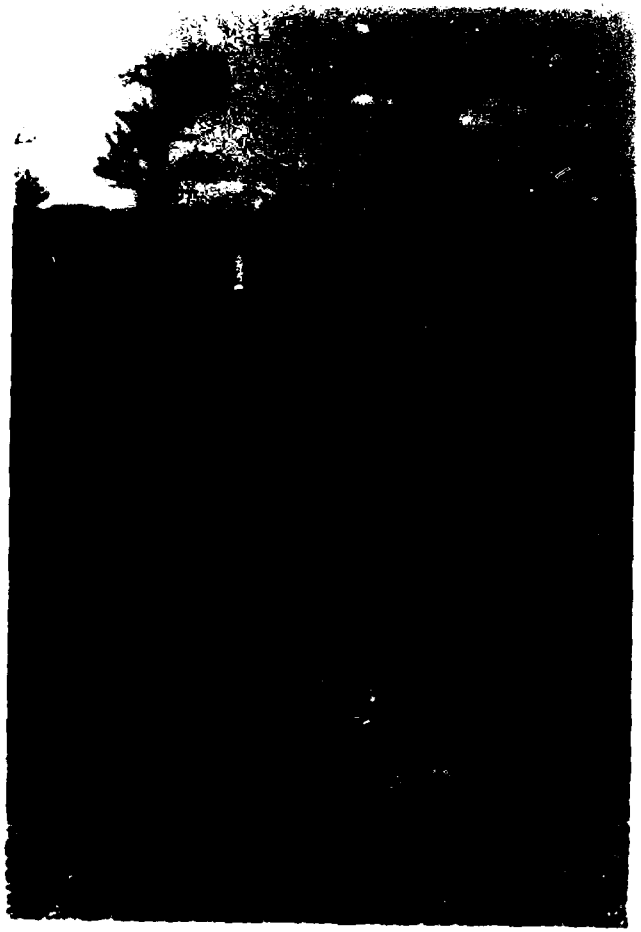
View of Road Culvert
Immediately Downstream of Dam

November, 1979

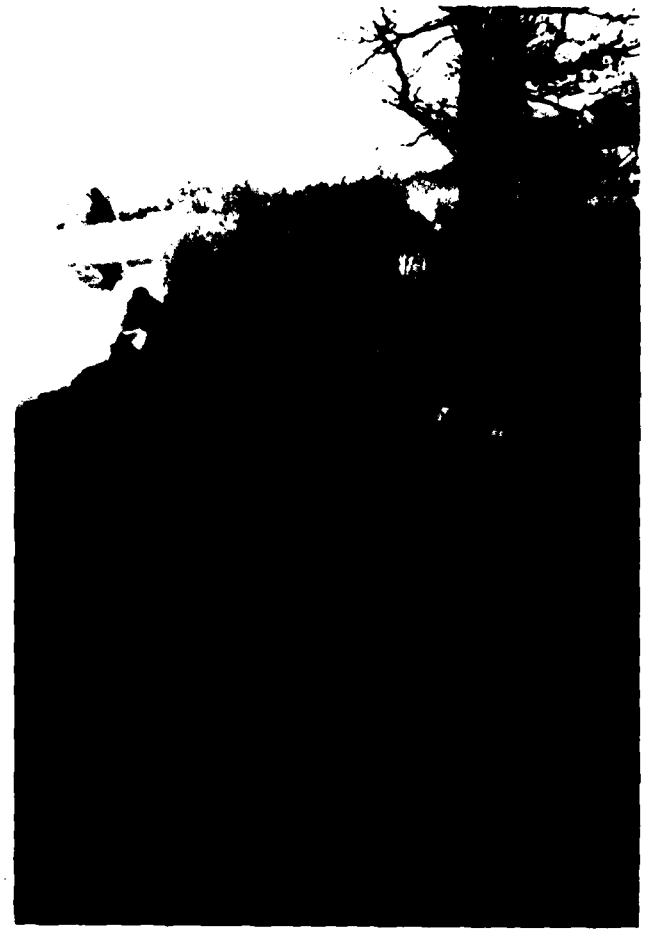
View of Spillway Inlet

November, 1979

View of Crest Looking East



November, 1979



November, 1979

View of Severely Eroded Embankment

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.85 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 74 MSL (160 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY):

ELEVATION MAXIMUM DESIGN POOL: 78 MSL (483 acre-feet)

ELEVATION TOP DAM: 78 MSL

CREST:

a. Elevation 78 MSL
b. Type Earth embankment
c. Width VARIES 12 - 14 feet
d. Length 600 feet
e. Location Spillover 200 feet in from the right abutment
f. Number and Type of Gates

OUTLET WORKS:

a. Type Timber drop inlet
b. Location Right abutment
c. Entrance inverts 74 MSL
d. Exit inverts 67± MSL
e. Emergency draindown facilities 4 sets of timber flashboards

HYDROMETEOROLOGICAL GAGES: None
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 487 cfs

BY L. B. DATE 4/7/80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF

CHKD. BY DATE INDIAN MILLS DAM NJ00042 PROJECT C-246

SUBJECT UNIT HYDROGRAPH DETERMINATION

STREAM TRIBUTARY: MUSKINGUM BROOK

D.A.: 5.85 SQ. MI.

TIME OF CONCENTRATION

CALIFORNIA CULVERTS METHOD

$$T_c = \left(\frac{11.9 \times L^3}{H}\right)^{0.385}$$

L = 19500 feet = 3.7 miles

H = 130 − 73 = 57'

$$T_c = \left(\frac{11.9 \times (3.7)^3}{57}\right)^{0.385} = 2.5 \text{ HRS}$$

US NAVY & TEXAS HIGHWAY DEPARTMENT METHOD

Channel flow H = 90 − 73 = 17'

AVG. SLOPE OF CHANNEL: 17/13000 = .0013 = 0.13 %

USE 1 ft/sec velocity

$$T = \frac{13000}{1 \times 3600} = 3.6 \text{ HRS}$$

OVERLAND FLOW

SLOPE: 130 − 90/6500 = .0062 = .62%

USE ≈ 1.5 ft/sec velocity

$$T = \frac{6500}{1.5 \times 3600} = 1.2 \text{ HRS}$$

Total T_c = 3.6 + 1.2 = 4.8 HRS

USE AVERAGE OF BOTH METHODS

∴ T_c = 3.65 HRS

BY L.B. DATE 4-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A2 OF

CHKD. BY DATE INDIAN MILLS DAM PROJECT S.244

SUBJECT UNIT HYDROGRAPH DETERMINATION

METHODOLOGY: SCS UNIT HYDROGRAPH w/CURVILINEAR TRANSFORMATION

GIVEN: $T_c = 3.65$ HRS, $D = 0.5$ HRS, D.A $= 5.85\ mi^2$, $Q = 1"$

$$T_p = D/2 + 0.6\,T_c = \frac{.5}{2} + .6(3.65)$$

$$T_p = 2.44 \text{ HRS}$$

$$Q_p = \frac{484 \times D.A. \times 1"}{T_p} = \frac{484 \times 5.85 \times 1}{2.44}$$

$$= 1160 \text{ CFS}$$

TIME	T/Tp	DIMENSIONLESS ORDINATE (D.O.)	$Q_p \times DO = Q$
0.5	0.20	0.075	87
1.0	0.41	0.294	341
1.5	0.61	0.617	716
2.0	0.85	0.933	1082
2.5	1.02	0.999	1159
3.0	1.23	0.899	1043
3.5	1.43	0.7235	839
4.0	1.64	0.526	610
4.5	1.84	0.399	463
5.0	2.05	0.298	346
5.5	2.25	0.224	260
6.0	2.46	0.163	189
6.5	2.66	0.119	138
7.0	2.87	0.089	103
7.5	3.07	0.068	79
8.0	3.28	0.050	58
8.5	3.48	0.037	43
9.0	3.69	0.0283	33

BY J.C DATE 1/3/80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-3 OF

CHKD. BY DATE INDIAN MILLS DAM INSPECTION PROJECT C246

SUBJECT DEPTH-DURATION RAINFALL DATA FROM TP 40 & HMR 35

PRECIPITATION DATA FROM TP 40 (SEE DEPTH-DURATION CURVE)
100 YR FREQUENCY

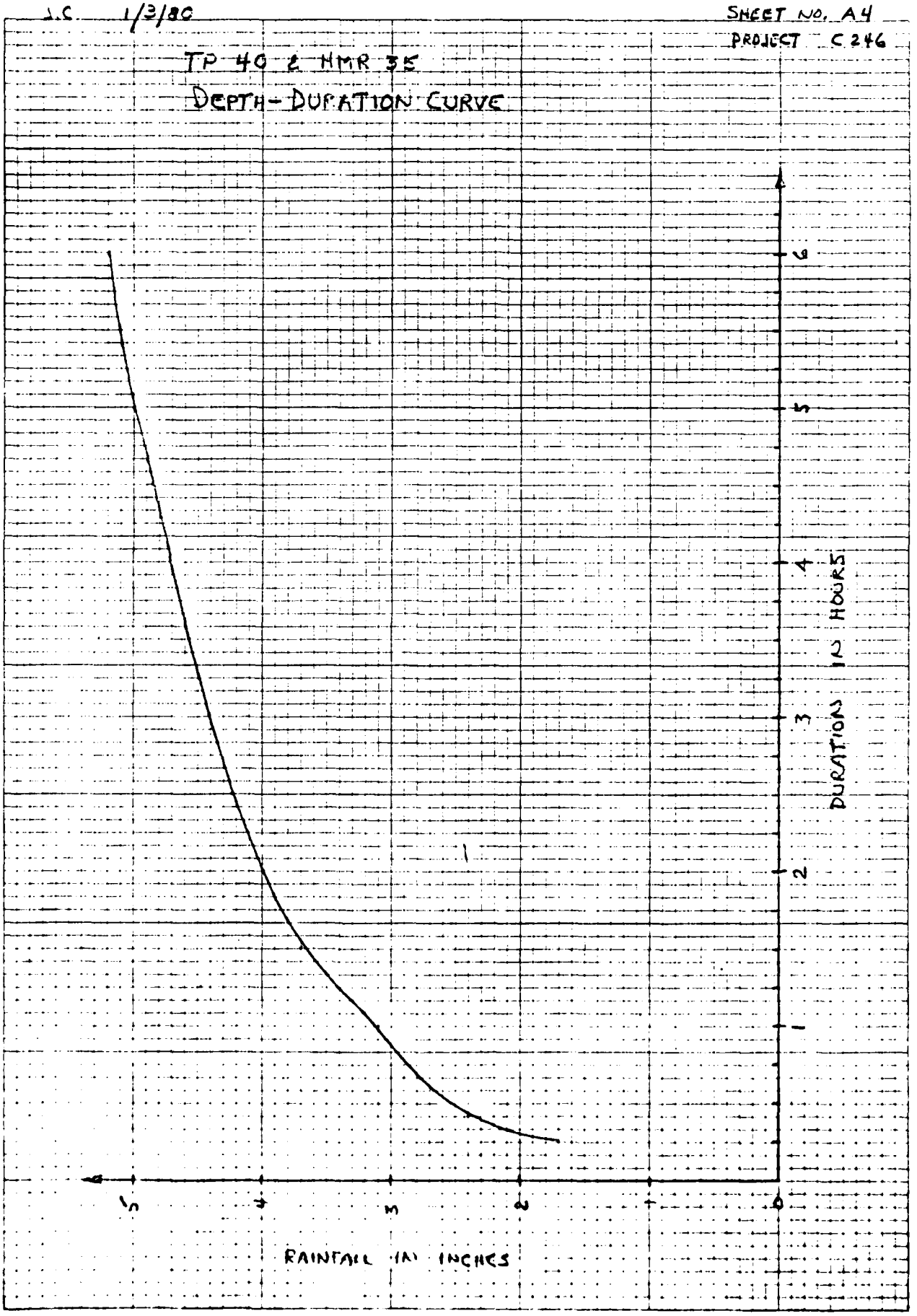
TIME	PRECIPITATION	Δ	REARRANGE Δ
0.5	2.4	2.4	0.12
1.0	3.1	0.7	0.12
1.5	3.7	0.6	0.14
2.0	4.0	0.3	0.17
2.5	4.22	0.22	0.18
3.0	4.40	0.18	0.22
3.5	4.57	0.17	0.7
4.0	4.71	0.14	2.4
4.5	4.84	0.13	0.6
5.0	4.96	0.12	0.3
5.5	5.08	0.12	0.13
6.0	5.20	0.12	0.12

J.C. 1/3/80

SHEET NO. A4

PROJECT C 246

TP 40 & HMR 35
DEPTH-DURATION CURVE

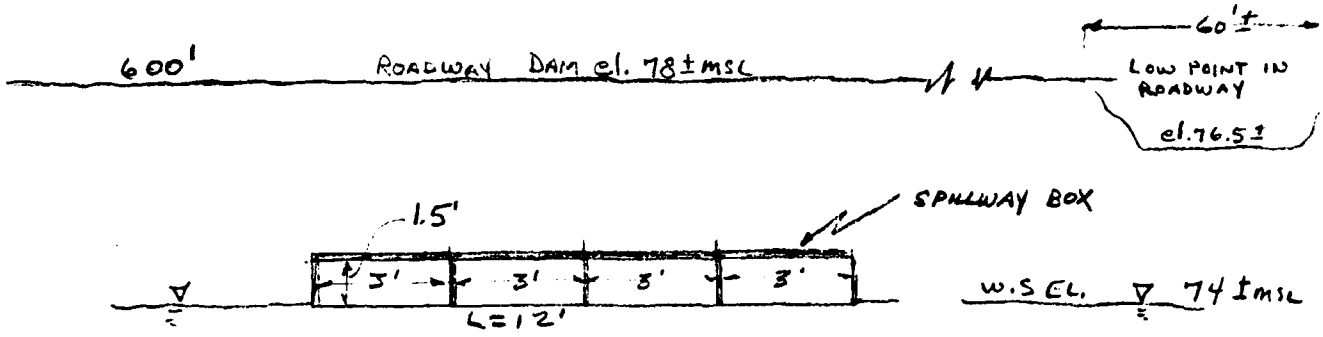


46 0706

BY J.C DATE 1/3/80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A5 OF

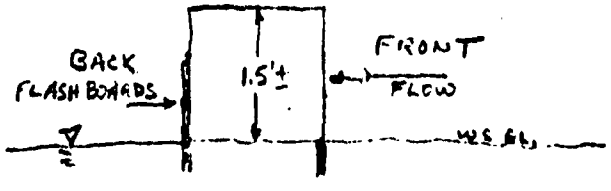
CHKD. BY DATE INDIAN MILLS DAM INSPECTION PROJECT C 246

SUBJECT SPILLWAY DISCHARGE CAPACITY



ELEV.	DEPTH H	$Q=CLH^{3/2}$ WEIR FLOW SPILLWAY C	L	Q	$Q=CA\sqrt{2gH}$ ORIFICE FLOW BOX C	A	Q	$Q=CLH^{3/2}$ LOW PT. OVERFLOW H	C	L	Q	$Q=CLH^{3/2}$ DAM OVERFLOW H	C	L	Q	TOTAL
74	0			0												0
75	1	3.3		40												40
75.5	1.5	3.3		73												73
76	2.0				.62	18"	127									127
76.5	2.5				.62	18	142	0								142
77	3.0				"	"	155	.5	2.8	60'	59					214
78	4.0				"	"	179	1.5	"	"	308	0				487
79	5.0				"	"	200	2.5	"	"	664	1	2.8'	60'	1680	2472
80	6.0						219	3.5	"	"	1100	2	"	"	4752	6071
81	7.0						237	4.5	"	"	1604	3	"	"	8729	10,570

NOTE : IT WAS ASSUMED THAT SPILLWAY DISCHANGE IS THROUGH THE FRONT OF SPILLWAY BOX ONLY

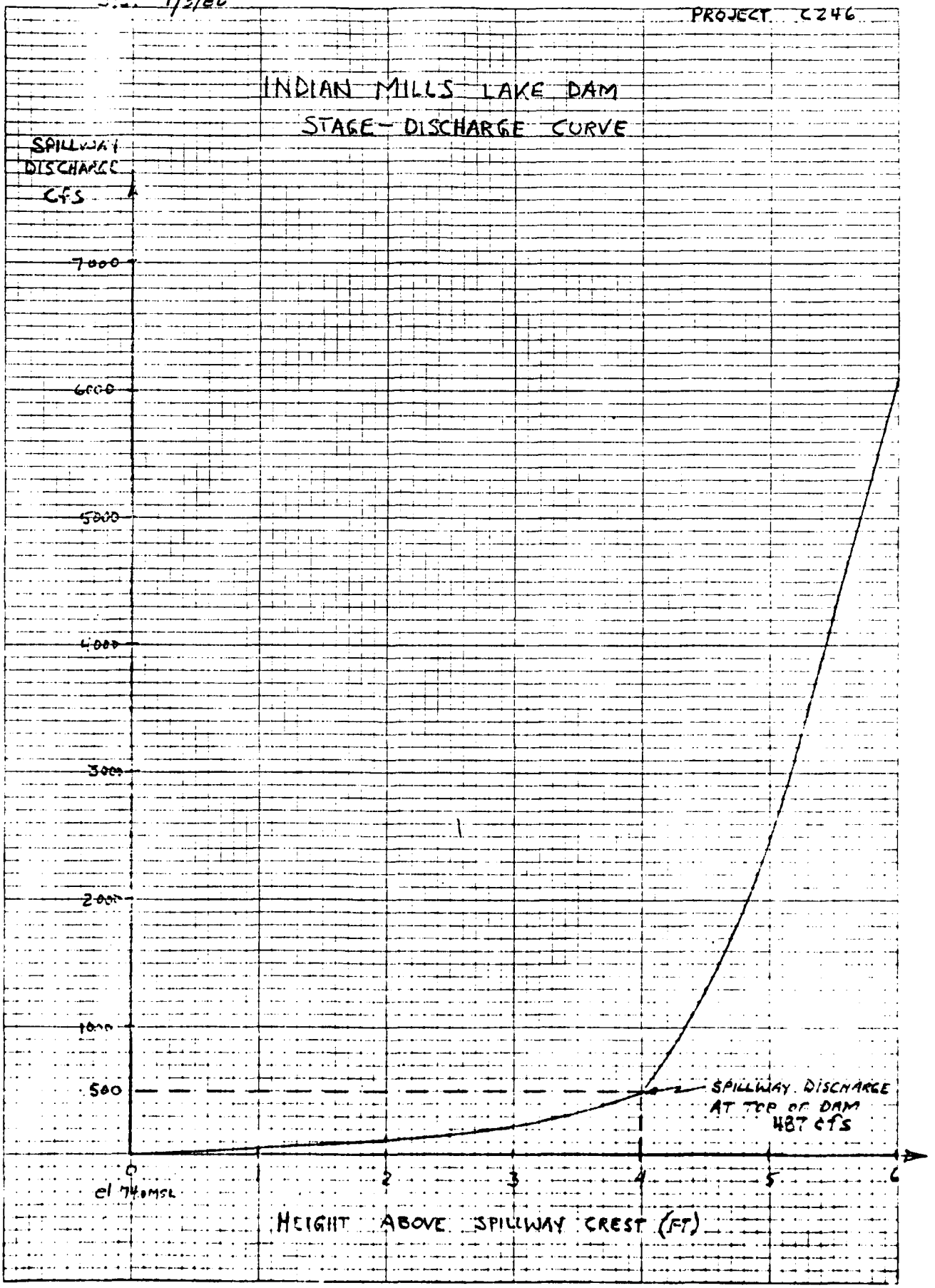


SIDE VIEW OF SPILLWAY BOX

SHEET NO. A6
PROJECT C246

1/3/80

INDIAN MILLS LAKE DAM
STAGE - DISCHARGE CURVE



46 0706

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

BY J.C. DATE 1/3/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A7 OF

CHKD. BY DATE INDIAN MILLS DAM PROJECT C.246

SUBJECT SURCHARGE STORAGE

AREA OF LAKE - 40 AC. @ elev. 74 MSL

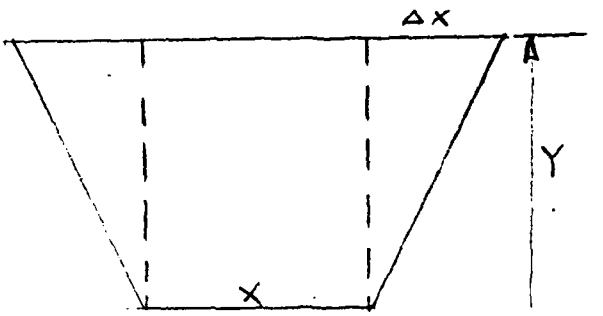
AREA OF LAKE - 45 AC @ elev 76 MSL

AREA OF CONTOUR - 350 AC. @ elev. 80 MSL

$\frac{45-40}{2} = 2.5 \frac{AC}{FT}$

$\Delta X = \frac{2.5}{2} = 1.25 AC.$

$\frac{350-45}{4} = 76.25 AC/FT.$ $\Delta X = \frac{76.25}{2} = 38.1$ AC/FT.



INCREMENT IN VOLUME $\Delta V = (X + \Delta X)Y$

SURCHARGE CALCULATED IN 2 STAGES (el. 74 to 76) & (el. 76 to 80)

ELEV.	HEIGHT ABOVE CREST (FT)	X + ΔX	Y	SURCHARGE STORAGE ACRE-FT.	
74	0				
75	1	41.3	(1)	41	
76	2	42.5	(2)	85	
77	3	80.6	(1)	1166	(80+85)
78	4	119	(2)	323	(238+85)
79	5	157	(3)	556	(471+85)
80	6	195	(4)	865	(780+85)

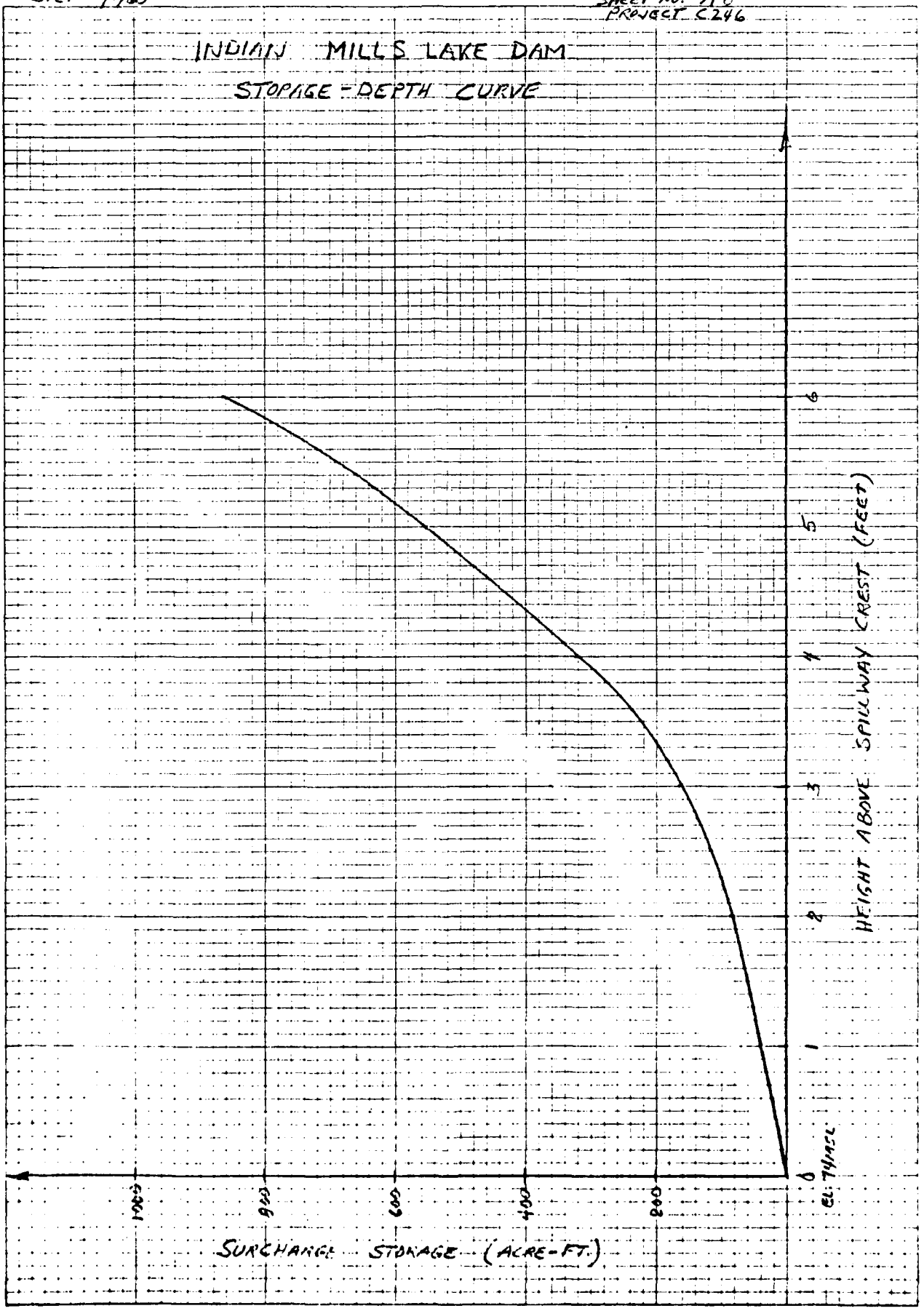
NOTE: STORAGE GIVEN TO NEAREST ACRE-FT.

J.C. 1/3/80

SHEET No. A 8
PROJECT C246

INDIAN MILLS LAKE DAM

STORAGE - DEPTH CURVE



46 0706

K&E 10 X 10 TO THE INCH
KEUFFEL & ESSER CO

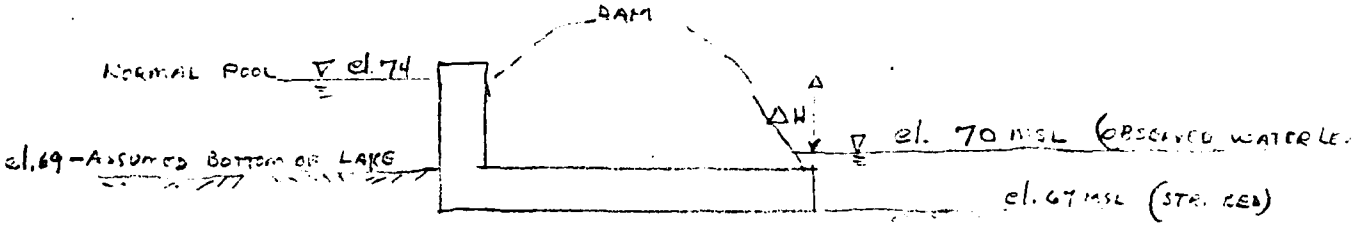
BY J.C DATE 1/4/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A-9 OF

CHKD. BY DATE INDIAN MILLS LAKE DAM PROJECT C-246

SUBJECT DRAWDOWN COMPUTATIONS

DRAWDOWN FROM NORMAL POOL ELEVATION

GIVEN:
1. LAKE AREA AT NORM. POOL EL. 74 MSL : 40 acres
2. ASSUME INFLOW OF 1 CFS PER SQ. MI. = ≈ 6 cfs
3. STORAGE VOLUME : ASSUMING 4' AVG. DEPTH — 160 AC-FT.
4. OUTLET BOX IS ≈1' BELOW WATER LEVEL ON DOWNSTREAM END
5. ASSUME TAILWATER REMAINS CONSTANT TO EL. 70
5. ASSUME OUTLET BOX IS 2' HIGH X APPROX. 12' WIDE
6. EFFECTIVE WIDTH (SAME AS SPILLWAY WIDTH)



IF $r = .86$ $\ell L = 40'$ $C = .78$ TABLE 4-11 KINGS HANDBOOK OF HYDRAULICS 5TH ED.

OUTFLOW = $C_d V \ell_j \Delta H$

N.P. 74 MSL

Assumed el. 69

ELEV.	AVG ΔH	Q	ASSUMED AREA AT ELEV	AVG STORAGE PER FT. AC.FT	TIME
74			40 AC		
	3.5	281	$\frac{40+36.8}{2} \times 1' =$	38.4	1.7
73			36.8		
	2.5	237		352	1.8
72			33.6		
	1.5	184		320	2.2
71			30.4		
	0.5	106		28.8	3.5
70*			27.2		
		36		25.6	10.3
60			24.0		

TOTAL TIME = 19.5 HRS

* ASSUME DOWN STREAM IS LOWERED & TAILWATER = 0 INLET CONTROL-CULVERT FLOW

$$\text{TIME} = \frac{\text{STORAGE} \times 43{,}560}{Q \times 3690}$$

* USING HYDRAULIC CHARTS FOR THE SELECTION OF HIGHWAY CULVERTS HYD ENG CIR. #5 CHART 1

```
A   INDIAN MILLS LAKE DAM INSPECTION NJ00042

A   INDIAN MILLS LAKE DAM INSPECTION NJ00042
A   BY J. CERAVOLO
A   JANUARY 1980
B    150       0       30
I      3
K      0       1                                          1
I   SUB-AREA RUNOFF COMPUTATION
M      0      -1    5.85
O     12
I    .12     .12     .14     .17     .18     .22      .7     2.4      .6      .3
I    .13     .12
T                                                       .5      .1
U     18
I     87     341     716    1082    1159    1043     839     610     463     346
I    260     189     139     103      79      58      43      33
X      0       0       1
K      1      11                                          1
I   HYDROGRAPH ROUTING
Y                              1
I      1
2      0      41      85     166     323     556     865
3      0      40     127     214     487    2472    6071
K     99
A
A
A
A
A
```

HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01

INDIAN MILLS LAKE DAM INSPECTION NJ00042
BY J. CERAVOLO
JANUARY 1980

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	30	0	0	0	0	0	0	0

JOPER	NUT
3	0

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SUB-AREA RUNOFF COMPUTATION

SUB-AREA RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	IHNAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	5.85	0.00	0.00	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
12	0.00	0.00	0.00

PRECIP PATTERN

0.12	0.12	0.14	0.17	0.18	0.22	0.70	2.40	0.60	0.30
0.13	0.12								

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

GIVEN UNIT GRAPH, NUHGG= 18

87.	341.	716.	1082.	1159.	1043.	839.	610.	463.	346.
260.	189.	138.	103.	79.	58.	43.	33.		

UNIT GRAPH TOTALS 7589. CFS OR 1.01 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.12	0.00	0.
2	0.12	0.00	0.
3	0.14	0.00	0.
4	0.17	0.04	3.

A11

5	0.18	0.13	23.
6	0.22	0.17	84.
7	0.70	0.65	246.
8	2.40	2.35	729.
9	0.60	0.55	1686.
10	0.30	0.25	2957.
11	0.13	0.08	4090.
12	0.12	0.07	4447.
13	0.00	0.00	4162.
14	0.00	0.00	3501.
15	0.00	0.00	2724.
16	0.00	0.00	2096.
17	0.00	0.00	1583.
18	0.00	0.00	1187.
19	0.00	0.00	873.
20	0.00	0.00	643.
21	0.00	0.00	478.
22	0.00	0.00	359.
23	0.00	0.00	263.
24	0.00	0.00	192.
25	0.00	0.00	129.
26	0.00	0.00	39.
27	0.00	0.00	16.
28	0.00	0.00	6.
29	0.00	0.00	2.
30	0.00	0.00	0.
31	0.00	0.00	0.
32	0.00	0.00	0.
33	0.00	0.00	0.
34	0.00	0.00	0.
35	0.00	0.00	0.
36	0.00	0.00	0.
37	0.00	0.00	0.
38	0.00	0.00	0.
39	0.00	0.00	0.
40	0.00	0.00	0.
41	0.00	0.00	0.
42	0.00	0.00	0.
43	0.00	0.00	0.
44	0.00	0.00	0.
45	0.00	0.00	0.
46	0.00	0.00	0.
47	0.00	0.00	0.
48	0.00	0.00	0.
49	0.00	0.00	0.
50	0.00	0.00	0.
51	0.00	0.00	0.
52	0.00	0.00	0.
53	0.00	0.00	0.
54	0.00	0.00	0.
55	0.00	0.00	0.
56	0.00	0.00	0.
57	0.00	0.00	0.
58	0.00	0.00	0.
59	0.00	0.00	0.

60	0.00	0.00	0.
61	0.00	0.00	0.
62	0.00	0.00	0.
63	0.00	0.00	0.
64	0.00	0.00	0.
65	0.00	0.00	0.
66	0.00	0.00	0.
67	0.00	0.00	0.
68	0.00	0.00	0.
69	0.00	0.00	0.
70	0.00	0.00	0.
71	0.00	0.00	0.
72	0.00	0.00	0.
73	0.00	0.00	0.
74	0.00	0.00	0.
75	0.00	0.00	0.
76	0.00	0.00	0.
77	0.00	0.00	0.
78	0.00	0.00	0.
79	0.00	0.00	0.
80	0.00	0.00	0.
81	0.00	0.00	0.
82	0.00	0.00	0.
83	0.00	0.00	0.
84	0.00	0.00	0.
85	0.00	0.00	0.
86	0.00	0.00	0.
87	0.00	0.00	0.
88	0.00	0.00	0.
89	0.00	0.00	0.
90	0.00	0.00	0.
91	0.00	0.00	0.
92	0.00	0.00	0.
93	0.00	0.00	0.
94	0.00	0.00	0.
95	0.00	0.00	0.
96	0.00	0.00	0.
97	0.00	0.00	0.
98	0.00	0.00	0.
99	0.00	0.00	0.
100	0.00	0.00	0.
101	0.00	0.00	0.
102	0.00	0.00	0.
103	0.00	0.00	0.
104	0.00	0.00	0.
105	0.00	0.00	0.
106	0.00	0.00	0.
107	0.00	0.00	0.
108	0.00	0.00	0.
109	0.00	0.00	0.
110	0.00	0.00	0.
111	0.00	0.00	0.
112	0.00	0.00	0.
113	0.00	0.00	0.
114	0.00	0.00	0.

115	0.00	0.00	0.
116	0.00	0.00	0.
117	0.00	0.00	0.
118	0.00	0.00	0.
119	0.00	0.00	0.
120	0.00	0.00	0.
121	0.00	0.00	0.
122	0.00	0.00	0.
123	0.00	0.00	0.
124	0.00	0.00	0.
125	0.00	0.00	0.
126	0.00	0.00	0.
127	0.00	0.00	0.
128	0.00	0.00	0.
129	0.00	0.00	0.
130	0.00	0.00	0.
131	0.00	0.00	0.
132	0.00	0.00	0.
133	0.00	0.00	0.
134	0.00	0.00	0.
135	0.00	0.00	0.
136	0.00	0.00	0.
137	0.00	0.00	0.
138	0.00	0.00	0.
139	0.00	0.00	0.
140	0.00	0.00	0.
141	0.00	0.00	0.
142	0.00	0.00	0.
143	0.00	0.00	0.
144	0.00	0.00	0.
145	0.00	0.00	0.
146	0.00	0.00	0.
147	0.00	0.00	0.
148	0.00	0.00	0.
149	0.00	0.00	0.
150	0.00	0.00	0.
SUM	5.20	4.29	32518.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4447.	2503.	678.	226.	32521.
INCHES		3.98	4.31	4.31	4.31
AC-FT		1242.	1345.	1345.	1345.

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HYDROGRAPH ROUTING

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
11	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME

A14

				0.0	0.000	0.00		1	0		

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.000	0.000	0.000	0.

STORAGE=	0.	41.	85.	166.	323.	556.	865.	0.	0.	0.
OUTFLOW=	0.	40.	127.	214.	487.	2472.	6071.	0.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	2.	0.
5	1.	13.	1.
6	3.	54.	3.
7	9.	165.	9.
8	29.	488.	28.
9	76.	1208.	109.
10	165.	2322.	213.
11	297.	3524.	442.
12	435.	4269.	1439.
13	535.	4304.	2296.
14	588.	3831.	2840.
15	597.	3113.	2946.
16	579.	2410.	2738.
17	549.	1840.	2408.
18	513.	1385.	2102.
19	475.	1030.	1781.
20	439.	758.	1475.
21	407.	560.	1201.
22	379.	419.	967.
23	356.	311.	771.
24	337.	228.	608.
25	321.	161.	484.
26	305.	84.	456.
27	288.	27.	427.
28	272.	11.	398.
29	256.	4.	370.
30	241.	1.	345.
31	227.	0.	321.
32	215.	0.	299.
33	203.	0.	278.
34	192.	0.	259.
35	181.	0.	241.
36	172.	0.	224.
37	163.	0.	211.
38	154.	0.	201.
39	146.	0.	193.
40	138.	0.	184.
41	131.	0.	176.
42	124.	0.	169.
43	117.	0.	161.
44	110.	0.	154.
45	104.	0.	148.
46	98.	0.	141.

47	93.	0.	135.
48	87.	0.	129.
49	82.	0.	121.
50	77.	0.	111.
51	73.	0.	103.
52	69.	0.	95.
53	65.	0.	87.
54	61.	0.	80.
55	58.	0.	74.
56	55.	0.	68.
57	53.	0.	63.
58	50.	0.	58.
59	48.	0.	53.
60	46.	0.	49.
61	44.	0.	45.
62	42.	0.	42.
63	40.	0.	39.
64	39.	0.	38.
65	37.	0.	36.
66	36.	0.	35.
67	34.	0.	33.
68	33.	0.	32.
69	32.	0.	31.
70	30.	0.	30.
71	29.	0.	28.
72	28.	0.	27.
73	27.	0.	26.
74	26.	0.	25.
75	25.	0.	24.
76	24.	0.	23.
77	23.	0.	22.
78	22.	0.	21.
79	21.	0.	21.
80	20.	0.	20.
81	19.	0.	19.
82	19.	0.	18.
83	18.	0.	18.
84	17.	0.	17.
85	17.	0.	16.
86	16.	0.	16.
87	15.	0.	15.
88	15.	0.	14.
89	14.	0.	14.
90	14.	0.	13.
91	13.	0.	13.
92	12.	0.	12.
93	12.	0.	12.
94	12.	0.	11.
95	11.	0.	11.
96	11.	0.	10.
97	10.	0.	10.
98	10.	0.	10.
99	9.	0.	9.
100	9.	0.	9.
101	9.	0.	8.

102	8.	0.	8.
103	8.	0.	8.
104	8.	0.	8.
105	7.	0.	7.
106	7.	0.	7.
107	7.	0.	7.
108	7.	0.	6.
109	6.	0.	6.
110	6.	0.	6.
111	6.	0.	6.
112	6.	0.	5.
113	5.	0.	5.
114	5.	0.	5.
115	5.	0.	5.
116	5.	0.	5.
117	5.	0.	4.
118	4.	0.	4.
119	4.	0.	4.
120	4.	0.	4.
121	4.	0.	4.
122	4.	0.	4.
123	4.	0.	3.
124	3.	0.	3.
125	3.	0.	3.
126	3.	0.	3.
127	3.	0.	3.
128	3.	0.	3.
129	3.	0.	3.
130	3.	0.	3.
131	3.	0.	3.
132	2.	0.	2.
133	2.	0.	2.
134	2.	0.	2.
135	2.	0.	2.
136	2.	0.	2.
137	2.	0.	2.
138	2.	0.	2.
139	2.	0.	2.
140	2.	0.	2.
141	2.	0.	2.
142	2.	0.	2.
143	2.	0.	2.
144	2.	0.	1.
145	1.	0.	1.
146	1.	0.	1.
147	1.	0.	1.
148	1.	0.	1.
149	1.	0.	1.
150	1.	0.	1.
SUM			32493.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2946.	1914.	650.	226.	32493.
INCHES		3.04	4.13	4.31	4.31

AC-FT	949.	1289.	1343.	1343.	

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RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	4447.	2503.	678.	226.	5.85
ROUTED TO	11	2946.	1914.	650.	226.	5.85